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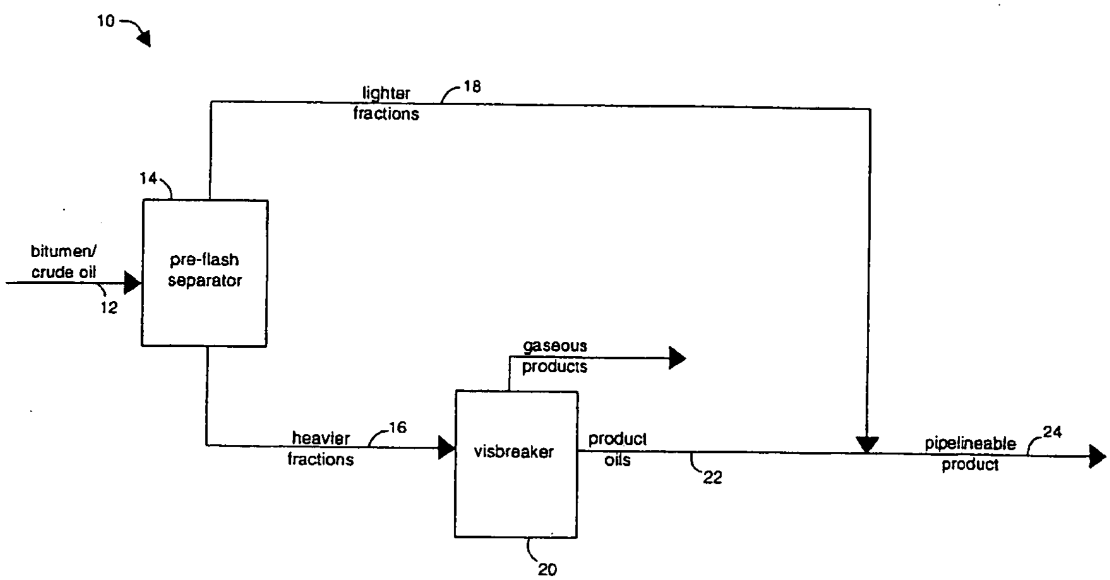
(54) **PROCEDE DE PRODUCTION, A PARTIR D'HYDROCARBURES LOURDS, D'HUILE TRANSPORTABLE PAR PIPELINE**

(54) **PROCESS FOR THE PRODUCTION OF PIPELINEABLE CRUDE OIL FROM HEAVIER HYDROCARBONS**



(57) Procédé de production, à partir de pétrole lourd et(ou) de bitume, d'huile brute stable transportable par pipeline. Comprend le chargement du pétrole lourd ou du bitume dans un appareil de chauffage à combustible, soit directement, soit après préchauffage. Les matières chargées sont chauffées à température élevée assez longtemps pour en réduire la viscosité; ou bien chauffées à température plus basse puis transvidées pour un long séchage destiné à en abaisser la viscosité. L'huile lourde ou le bitume chargé peut être préfractionné pour enlever les fractions plus légères avant de transvider la fraction plus lourde dans l'appareil à chauffer ou à chauffer/sécher dont sortiront les produits viscoréduits constituant l'huile brute transportable par pipeline. À des fins de prédistillation, les fractions plus légères sont réassociées au produit viscoréduit pour transport par pipeline.

(57) A process for the production of stable, pipelineable crude oil from heavy oils and/or bitumen that comprises feeding the heavy oils or bitumens either directly or after preheating into a fired heater. The feed is heated and kept at an elevated temperature long enough to break the viscosity. Alternatively, the feed is heated to a lesser temperature and transferred to a vessel for soaking over a longer time to break its viscosity. The heavy oil or bitumen feed may be prefractioned to removed lighter fractions prior to transferring the heavier fraction to the heater or heater/soaker which outputs visbroken products with lowered viscosity that are pipelineable crude oil. For predistillation, the lighter fractions are recombined with the visbroken product for pipeline transport.

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ABSTRACT OF THE DISCLOSURE

A process for the production of stable, pipelineable crude oil from heavy oils and/or bitumen that comprises feeding the heavy oils or bitumens either directly or after preheating into a fired heater. The feed is heated and kept at an elevated temperature long enough to break the viscosity. Alternatively, the feed is heated to a lesser temperature and transferred to a vessel for soaking over a longer time to break its viscosity. The heavy oil or bitumen feed may be prefractioned to removed lighter fractions prior to transferring the heavier fraction to the heater or heater/soaker which outputs visbroken products with lowered viscosity that are pipelineable crude oil. For predistillation, the lighter fractions are recombined with the visbroken product for pipeline transport.

PROCESS FOR THE PRODUCTION OF PIPELINEABLE CRUDE OIL FROM HEAVIER HYDROCARBONS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates generally to the conversion of heavy crude oils and bitumen to a stable product suitable for pipeline transportation and specifically to methods for producing pipelineable crude oil from heavier, high viscosity hydrocarbons.

2. Description of the Prior Art

In petroleum refining, "visbreakers" are cooking vessels that are used to thermally break down thick, viscous "short resid" fractions into more fluid liquids, such as fuel oils. Crude oil fractions can be characterized by their respective boiling points. The short resids generally have boiling points above 500 degrees Centigrade. Very light, highly volatile fractions are usually considered to have boiling points under 200 degrees Centigrade. Both coil-type and soaker-type visbreakers have been used for the production of fuel oils for use in combustion burners. The conventional practice is to visbreak hydrocarbon fractions with boiling points over 500 degrees Centigrade.

In order to produce a stable fuel oil, visbreakers are generally operated at a severity intended to produce five to six weight percent of light fractions boiling below 200 degrees Centigrade. Visbreakers that are operated too aggressively or too "severely", overcrack the short resids and produce more than the nominal five to six percent, by weight, of light fractions which boil under 200 degrees Centigrade. Visbreaker conversions yielding between six and seven percent, by weight, light fractions having boiling points under 200 degrees Centigrade are often unstable, meaning the fuel oil product will not stay homogenized. The American standards association, ASTM, defines in standard D4740 a process for testing and rating such stability, e.g., #1, #2, etc. where #1 is the highest rating and #4 the lowest. Conventional conversions with visbreakers yielding over seven percent light fractions having boiling points under 200 degrees Centigrade are almost always unstable.

Unstable fuel oils contain solids and/or gelatinous products which cause fouling during transporting and pumping. When such unstable fuel oil reaches the end user, such precipitates can also foul heat exchanger, instruments as well as combustion burners of equipment used to produce heat. In conventional practice, unstable fuel oils are produced whenever the visbreaking is too aggressive.

Poorer products are produced, at any given conversion level, by coil-type visbreakers which use temperatures of about 482 degrees Centigrade, compared to soaker-type visbreakers that operate with temperatures that are twenty to thirty degrees Centigrade lower than the coil-type visbreakers.

The extent of thermal cracking is always a function of the temperature and the exposure time. Soaker visbreakers use lower temperature and longer exposure times than coil visbreakers.

Apparently, the difference in product quality also stems from the shorter soaking time and a higher average temperature of coil-type visbreakers. Soaker-type visbreakers use lower temperatures that are compensated for by longer soak times. Such lower temperatures produce fewer olefinic and diolefinic byproducts.

The heavier fractions of crude oils are more susceptible than the lighter fractions to thermal cracking that occurs in visbreaking. Certain "wall effects" can influence the composition of thermally-cracked products. The temperatures in conventional visbreakers are not uniform, and both types use heater tubes. The heavy crude oil fractions with boiling points above 500 degrees Centigrade that contact the hot heater tubes, crack more deeply and more quickly than the same fractions that flow within the central part of the heater tubes. Furnace firing rates and tube arrangements therefore need to be critically adjusted to minimize such wall effects.

However it is practically impossible to completely eliminate wall effects, due to the nature of furnace heater configurations. As a consequence, the heavy fractions that contact the hot tube walls will overcrack, and thus lead to unstable products. To circumvent this, designers of visbreakers generally design the units for conversions of five to six weight percent. Conversions in excess of seven percent will almost always produce unstable products.

Thus conventional visbreakers feed short resids to the visbreaker, leading to contact of the heavy feed with a 500 degrees Centigrade, or higher initial boiling point, with hot tube surfaces. Since the heavy fractions are more susceptible to cracking than lighter materials, overcracking results with overextended soaking times. Lighter fractions also crack thermally, but at a much lower rate. When producing a pipelineable crude oil it is desirable to increase production of lighter materials, as well as to obtain as much reduction in viscosity as possible.

The prior art generally avoids visbreaking of bitumens with an initial boiling point below approximately 500 degrees Centigrade. Visbreaking bitumen short resids to produce a fuel oil has probably been tried. Visbreaking is universally used primarily for the production of lower viscosity fuel oils. Visbreaking of bitumens can be conducted with a feed stock free of clay and alumina. However, the inclusion of some of this

material has been found to provide a partial scrubbing action within the heater tubes, thus improving the heat exchange coefficient and thereby diminishing overcracking. The included solids may also provide some semi-catalytic action.

SUMMARY OF THE PRESENT INVENTION

It is therefore an object of the present invention to provide a process to maximize visbreaking to obtain a lower viscosity.

It is a further object of the present invention to provide a process for making stable pipeline-transportable products from heavy crude oils and/or bitumen.

Briefly, in a preferred process embodiment of the present invention, Athabasca bitumen having 0.1 to 3.0 percent, by weight, naturally-occurring metal oxides is preflashed into a heavy and a light fraction respectively having boiling points above 200 and above 370 degrees Centigrade. The heavy fractions are fed to a severe visbreaker set for conversions exceeding 7.5 percent, by weight. The products of the visbreaker are recombined with the preflashed light fractions to form a stable product oil. The whole feed bitumen can also be visbroken, without the preflash unit which would be a simpler, lower cost system but with some loss of efficiency.

Alternatively, the heavy fraction fed to the visbreaker has added to it 0.1 to 3.0 percent metal oxides, by weight, which oxides are preferably dominated by aluminum oxides.

An advantage of the present invention is that a process is provided for producing stable product oils from visbreakers at higher conversion rates.

A further advantage of the present invention is that a process is provided for making bitumen more easily transported in a pipeline.

These and other objects and advantages of the present invention will no doubt become obvious to those of ordinary skill in the art after having read the following detailed description of the preferred embodiments that are illustrated in the drawing figure.

IN THE DRAWINGS

Fig. 1 is a diagram of a process for producing lighter product oils for pipeline transportation from bitumen with a visbreaker operated at unusually high conversion rates.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 illustrates a process embodiment of the present invention, referred to herein by the general reference numeral 10. The process 10 receives a bitumen or crude oil flow 12 into a pre-flash separator 14. The flow 12 is separated into a heavy fraction flow 16 and a light fraction flow 18. A visbreaker 20, either a coil type or a soaker type, operated to produce a product oil flow 22 having a conversion of between 7.5 and nine percent, by weight, of light fractions with boiling points under 200 degrees Centigrade. Visbreaking also produces gaseous products consisting of butanes and lighter as well as hydrogen sulfide. The light fraction flow 18 is combined with the product oil flow 22 to form a stable pipeline-transportable product 24.

In a test that provided satisfactory results, the separator 14 was set such that the heavy fraction flow 16 had an initial boiling point above 316 degrees Centigrade. The light fraction flow 18 had constituents that all had boiling points below 316 degrees Centigrade. The inclusion of lighter fractions having boiling points down to 316 degrees Centigrade in the heavy fraction flow 16 with the more traditional short resid is estimated to have reduced the temperature gradients that occur due to the "wall effect" within the heating tubes in the visbreaker 20. The high temperature extremes that

overcrack the short resid are precluded by the more active slurry of flow 16. It is predicted that the separation of the heavy and light fraction flows 16 and 18 by the separator 14 with demarcation temperatures ranging from 200 to 370 degrees Centigrade can be expected to demonstrate most if not all of the advantages of the present invention.

Tests also included the use of Athabasca bitumen for the flow 12 that had naturally-occurring metallic oxides, which included alumina and silica, all in the amount of 0.6 percent, by weight. Such metallic oxides carried through to the heavy fraction flow 16 and seemed to aid the cracking by the visbreaker 20 to produce stable product oils in the flow 22, even at conversion rates approaching 8.75 percent, by weight. It is predicted that the presence of metallic oxides in the range of 0.1 to 3.0 percent, by weight, in the input flow 16, can be expected to yield output flows 24 that demonstrate most, if not all, of the advantages of the present invention. A predominance of aluminum oxides in the metallic oxides is predicted to produce even more favorable results. The presence of such metallic oxides also presumably improves the heat transfer coefficient and reduces the temperature gradients experienced in the visbreaker 20.

In producing pipelineable crude oil with the thermal-cracking technique, it is advantageous to maximize such visbreaking to get a lower viscosity, and a maximum amount of lighter products from the

full bitumen. Outside fuel oil production, such as pipeline preparation of bitumen, high-severity visbreaking is used to decrease the overall viscosity and increase the production of the light fractions. So severity can be maximized in order to produce a reconstituted bitumen or heavy oil having a volumetric yield of product boiling above butanes that is greater than the volumes fed to the unit. Such products have a considerably greater American Petroleum Institute (API) gravity rating than the bitumen, and a viscosity that has been sufficiently lowered to permit pipeline transportation of the reconstituted bitumen.

It was discovered, in a pilot plant operation, that it was possible to achieve a conversion of 8.34 percent, by weight, and still produce a stable product. The stability was determined according to the ASTM D4740 stability test. The results showed a rating of #1, the most stable. The pilot plant was also operated to give a conversion of 8.75 percent, by weight, wherein the stability tests indicated a rating of #2. So stable products are at least possible for conversion rates as much as two and a half percent more than was conventionally thought possible by artisans. Maximum conversion severity using the process of the present invention appears to be bracketed between 8.34 and 8.75 percent, by weight. This conversion is considerably in excess of the six to seven percent conversion which could be achieved by visbreaking the heavy fraction alone. The process 10 can be

applied to either normal crude oil fractions or bitumen, or combinations of the two.

In summary, a process for the production of stable, pipeline-transportable bitumen from heavy oils and bitumen comprises feeding the heavy oils or bitumens either directly or after preheating into a fired heater. The feed is heated and kept at an elevated temperature long enough to break the viscosity. Alternatively, the feed is heated to a lesser temperature and transferred to a vessel for soaking over a longer time to break its viscosity. The heavy oil or bitumen feed may be fractionated to remove lighter fractions prior to transferring the heavier fraction to the heater or heater/soaker which outputs visbroken products with lowered viscosity that are pipeline-transportable. For predistillation, the lighter fractions which have a low viscosity are recombined with the visbroken product for pipeline transport.

Such process differs from conventional visbreaking by transferring feedstocks with lighter than traditional fractions to the visbreaker. Metallic oxides are deliberately introduced to promote higher visbreaker conversion rates without the side effect of producing unstable products.

In the present invention, material is included which boils between 200 and 500 degrees Centigrade, together with the 500 degree Centigrade short resid bottoms which boil above 500 degrees Centigrade. Adding in this lighter fraction provides several benefits. Thermal cracking of the lighter

fraction, even though not too great, produces light hydrocarbons which decrease the viscosity and the specific gravity of the blend of all products. The presence of the lighter fraction, e.g., 200 to 500 degrees Centigrade, dilutes the heavy short resid and insulates it from overcracking at the hot tube walls. In effect, this means the heavy fractions hover more closely at the average temperature of the cross-sectional slice of the feed between the tube walls. The prevention of overcracking is desirable because it tends to enable the output of a stable product, at a higher conversion level, than can be achieved without the dilution effect of the lighter fraction.

Although the present invention has been described in terms of the presently preferred embodiments, it is to be understood that the disclosure is not to be interpreted as limiting. Various alterations and modifications will no doubt become apparent to those skilled in the art after having read the above disclosure. Accordingly, it is intended that the appended claims be interpreted as covering all alterations and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

IN THE CLAIMS

1. A process for the production of stable, pipelineable crude oils from heavy oils and bitumen, comprising:

feeding heavy oils or bitumens either directly or after preheating into a fired heater;

heating said feed to an elevated temperature and maintaining said temperature long enough to break the viscosity of said feed;

alternatively heating said heavy oil or bitumen feed to a lesser temperature and transferring said heavy oil or bitumen feed to a vessel for heat soaking over a relatively longer time to break its viscosity; wherein

said heavy oil or bitumen feed may be prefractioned to removed lighter fractions to the heater or heater/soaker providing for an output of visbroken products with lowered viscosity that are pipelineable.

2. The method of claim 1, wherein:

said step of feeding includes predistillation, and any lighter fractions are recombined with said visbroken product for pipeline transport.

3. A process for reducing the viscosity of bitumen and/or heavy crude oil for easier transportation by pipeline, comprising:

inputting a bitumen or crude oil flow into a pre-flash separator for separation into a heavy fraction flow "A" having a boiling point above a demarcation temperature in the range of 200 to 370 degrees Centigrade and a light fraction flow "B" having boiling point below said demarcation temperature;

converting said heavy fraction flow "A" with a visbreaker into a product oil flow "C" having a conversion rate of between 7.5 and nine percent, by weight, of light fractions with boiling points under 200 degrees Centigrade to the whole; and

adding light fraction flow "B" to the product oil flow "C" to form a stable pipeline-transportable flow "D".

4. The process of claim 3, wherein:

said pre-flash separator is set such that the heavy fraction flow "A" has an initial boiling point above 316 degrees Centigrade and the light fraction flow "B" has constituents that all have boiling points below 316 degrees Centigrade.

5. The process of claim 3, wherein:

said bitumen or crude oil flow comprises Athabasca bitumen with naturally-occurring metallic oxides, including alumina and silica, all in the amount of 0.6 percent, by weight.

6. The process of claim 3, wherein:

said visbreaker is operated at conversion rates ranging from 8.34 to 8.75 percent, by weight.

7. The process of claim 3, further comprising:

adding metallic oxides in the range of 0.1 to 3.0 percent, by weight into said heavy fraction flow "A".

8. The process of claim 7, wherein:

said added metallic oxides have a predominance of aluminum oxides.

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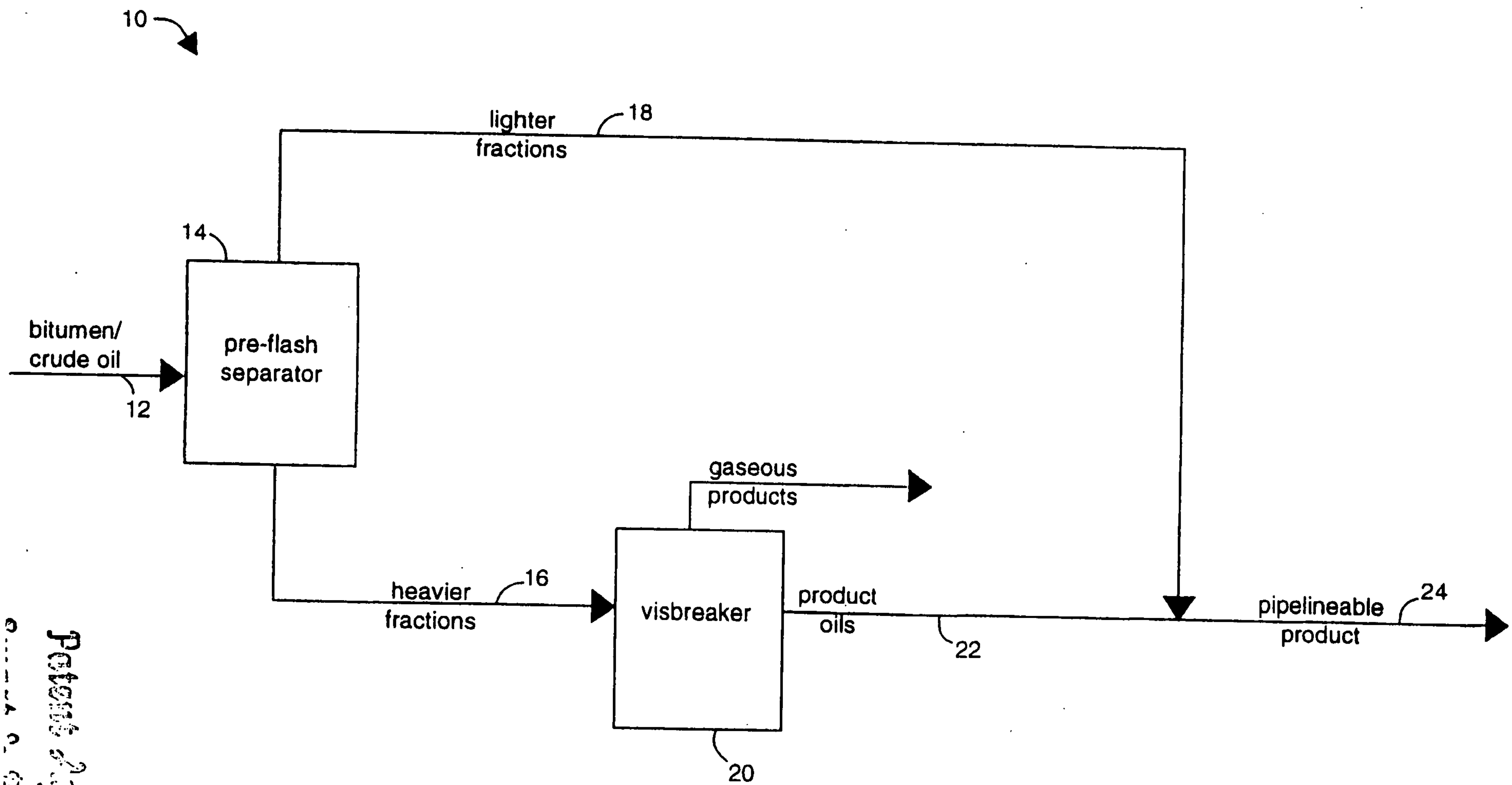
Fig. 1



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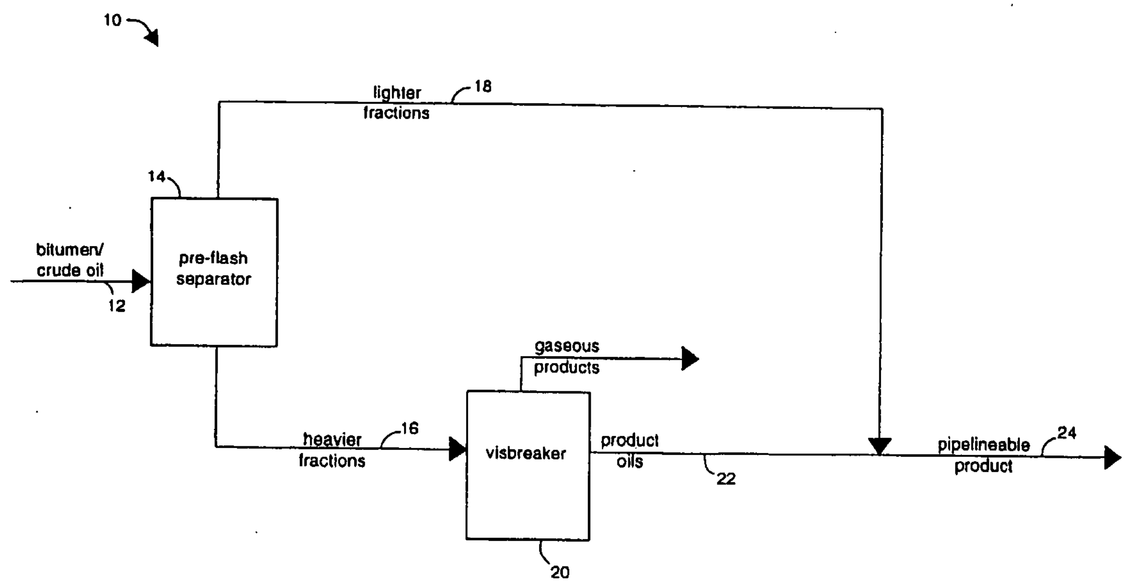
10
bitumen/
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12
14
pre-flash
separator
lighter
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products
product
oils
22
pipelineable
product
24